SESSION 9

Audits of Design-Build Projects

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What is Design/Build?

- When a single entity provides both design and construction through a single contract between the agency and the Design-Build contractor

- Primary Benefit: Time Savings

- Other Benefits:
  - ★ Singular Responsibility
  - ★ Reduced administration & inspection costs
  - ★ Reduce or eliminate change orders and claims due to "errors and omissions"
  - ★ Allow maximum contractor flexibility
  - ★ Allow innovation and new approaches which increases speed & quality

Roles in the Design/Build Process

- The owner/agency controls:
  - ★ The basic configuration and function of the highway product
  - ★ Certain design standards
  - ★ The period of time for which the warranty is required
  - ★ The performance requirements to be met during the warranty period

- The contracting organization is given the freedom to:
  - ★ Provide the design
  - ★ Choose materials and construction procedures
  - ★ Other decisions within the limits of the criteria and standards set by the contract documents

Safety Pitfalls in Design/Build

- Transfer in responsibility
- The design process is less controlled (and potentially less uniform)
- The bottom-line may drive some decisions
  - ★ Design engineers who become subcontractors to construction firms, could be placed in professionally-difficult positions in satisfying the contractor's desire for a competitive design, and the highway agency owner's desire for a high quality facility.
- Who is the guardian of the public safety?

Safety Precautions in Design/Build

- A Road Safety Audit is essential
- Can be initiated by either the contractor of the owner
- Conduct RSAs early in (at the RFP stage), and throughout the design/build process
- Establish a communication and reporting channel
- Establish a response mechanism

Design/Build Case Study Highway 407

- First Public-Private design/build project in Ontario
- 36 kms of an urban freeway with a design speed of 120 km/h, including interchanges
- Concerns raised by Ontario Provincial Police
- Independent Safety "Review" commissioned
- Concern over compliance with standards
  - ★ Sight distances at bull-nose
  - ★ Barrier protection lengths
  - ★ Median width
  - ★ Radii used on inner loop ramps

Design/Build Case Study Highway 407

- Specific recommendations
  - ★ Install crash cushions around high-mast light poles and median bridge piers
  - ★ Reshape median
  - ★ Shoulder rumble-strips
  - ★ Extension of barriers
  - ★ Flattening of slopes
  - ★ Increase surface friction on ramps
  - ★ Additional positive guidance at tight loop ramps

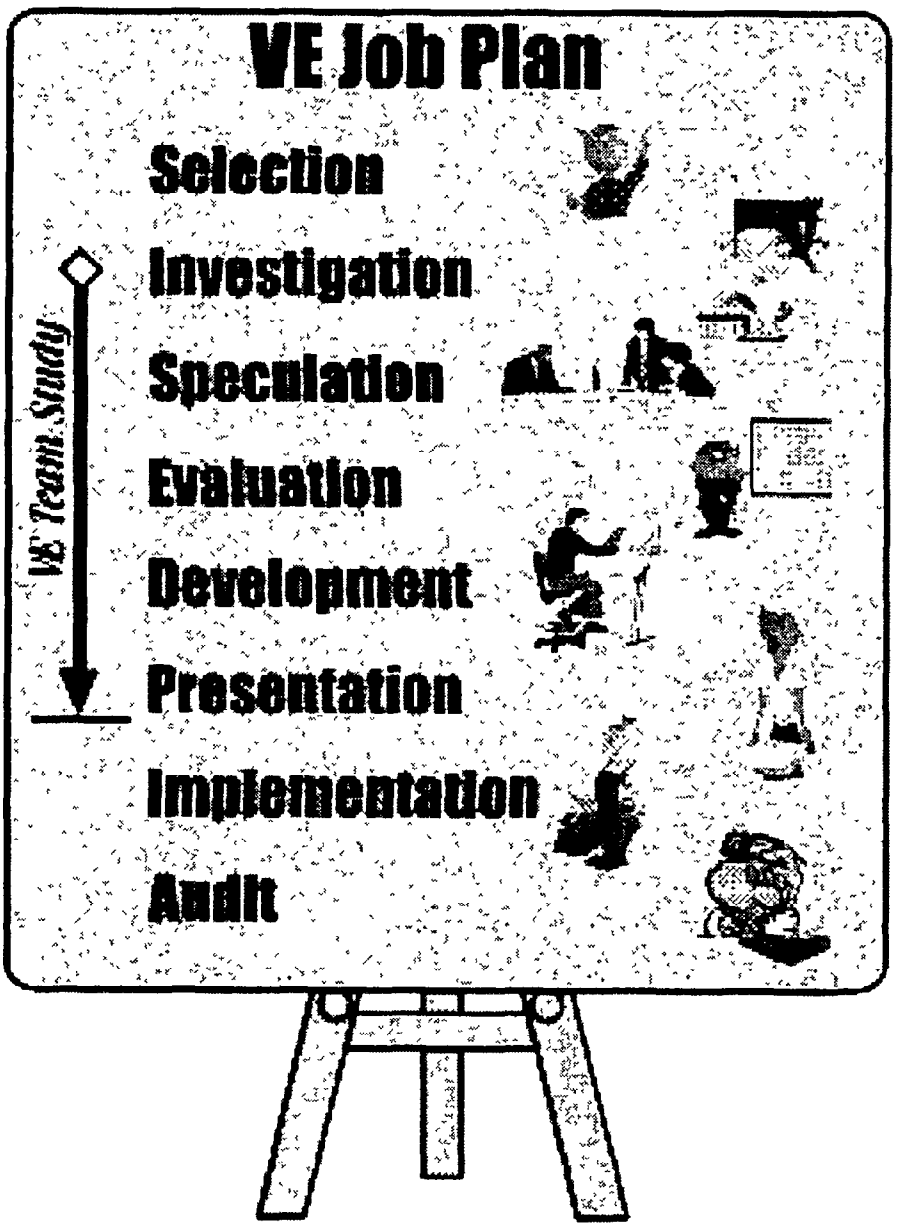
- General findings and admonitions
  - ★ Standards do not guarantee safety
  - ★ Standards should be exceeded not just met
  - ★ No single agency responsible for safety
  - ★ Explicit considerations of safety required

What is Value Engineering?

- The systematic application of recognized techniques by a multi-disciplined team to:
  - ★ Identify the function of a product or service
  - ★ Establish a worth for that function
  - ★ Generate alternatives through the use of creative thinking
  - ★ Provide the needed functions to accomplish the original purpose of the project, reliably, and at the lowest life-cycle cost without sacrificing safety, necessary quality, and environmental attributes of the project

(adapted from the FHWA)

The VE Process



Value Engineering

Safety Pitfalls of VE

- VE, if not done properly, can be reduced to a cost cutting exercise
- Intent of VE is the maintain the 'value'
- This includes either maintaining the same level of safety or ensuring that safety meets the same minimum criteria before and after the VE exercise
- Do we understand the safety implications of all our decisions? (ex., what are the safety tradeoffs associated with reducing a lane width from 3.7 metres to 3.5 metres?)

Safety Precautions for VE

- Three approaches to address safety
  - ★ Safety expertise on the VE team
  - ★ RSA of the VE recommendations
  - ★ Both of the above
- Must understand the life-cycle safety consequences of VE decisions
- The "value" of the project must consider the societal costs of crashes
- Look for positive and negative impacts on safety even when safety is not the focus (i.e., Moira River Bridge, Belleville, Ontario)

VE Case Study
Highway 69

- Existing 2 lane undivided highway with a posted speed of 90 km/h being expanded to a 4 lane, divided highway with a design speed of 120 km/h

- Rural terrain consisting of rock cuts, swamp and woodlands in equal proportions

- VE Safety Issue - Can we reduce the clear zone in the rock cuts, or use barriers, and save on construction cost?

- Task - Determine societal cost of rock face crashes with different cross-sections/clear zones to deliver the best value

VE Case Study
Highway 69

- Data Needs
  - ★ Rock cut characteristics: length, height, and offset from travel lane
  - ★ Crash statistics resulting in striking rock cut
  - ★ Societal cost of crashes
  - ★ Construction and maintenance costs
  - ★ Encroachment rates (adjusted for horizontal and vertical alignment)

- Reviewed 5 different cross-sections
  - ★ 5 metre offset without barrier
  - ★ 5 metre offset with concrete barrier
  - ★ 5 metre offset with guiderail barrier
  - ★ 7 metre offset without barrier
  - ★ 10 metre offset without barrier

VE Case Study
Highway 69

Total Life Cycle Costs

(Present Values)

Cross-section	Height of Rock Cut			
	1 m	2 m	3 m	4 m
10 m offset			770	1155
7 m offset	107	408		1010
5 m offset	335	580	825	1070
5 m c/w guiderail	237	482	727	
5 m c/w concrete	850	1095	1340	1585

Costs are in $1,000.

10 m offset with 1 m rock cut is the baseline for relative comparison with others.

SUMMARY

- Design/Build projects present the safety challenges of:
  - ★ Designating the individual/entity responsible for ensuring safety
  - ★ Tempering the contractor's desire to minimize cost with safety/quality considerations
- The value engineering process presents the safety challenges of:
  - ★ Understanding the safety implications of proposed changes to an undertaking
  - ★ Ensuring that the "value" of safety is included in decision-making
- RSAs are an essential tool required to meet these challenges

OTHER AUDITS & ISSUES
EVALUATION & CLOSURE

Road Safety Audit Seminar

ITE Annual Meeting

Las Vegas, Nevada, August 5, 1999

by

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OUTLNE

1. Planning Stage Audits

2. Value Engineering and Audits

3. Design/ Build and Audits

4. Other Issues

PLANNING STAGE AUDITS

- Route Choice
- Alignment
- Corridor Alternatives
- Road Classification
- Design Standards
- Project Scope
- Connectivity to Network

VALUE ENGINEERING AND AUDITS

- **Value Engineering Definition and Original Intent**

  Analysis of the function of a project performed by qualified personnel, directed at improving performance, reliability, quality, safety, and life-cycle costs.

- **Value Engineering in Practice**

- **Typical Process**

- **Implications to Safety**

- **Example:** **Highway 407, Ontario**
  Highway 1, British Columbia

ADDRESSING SAFETY IMPLICATIONS OF VALUE ENGINEERING

- Safety Expertise on the VE Team
- Safety Audit of VE Recommendations
- Or Both
- On Major Projects, A MUST – Not an Option
- Objective: As a Minimum, Seek to Understand Life-Cycle Safety Consequences of VE Decisions

DESIGN / BUILD AND AUDITS

- Transfer in Responsibility
- Gains in Efficiency
- Faster Implementation of Design and Construction
- Less Uniform and Less Controlled Design Process
- Susceptible to Bottom Line rather than Value Mentally
- Comparisons with Private Development Attitudes
- Implications to Safety
- Example: Westview Interchange, British Columbia
- Flag the Combination with Value Engineering

ADDRESSING SAFETY IMPLICATIONS OF DESIGN / BUILD PROJECTS

- Independent Safety Audits Essential
- Either by Proponent or Owner
- Introduce at RFP and Proposal Submission Stage (Preliminary Design)
- Establish Communication and Reporting Channel
- Establish Response Mechanism
- Objective: Do Not Lose the Role of the Guardian of Safety

OTHER ISSUES

- Design Safety Reviews
- Blackspot Operational Reviews
- Maintenance Checks – signs, markings, pavement
- Regular Safety Reviews of Network
- Construction / Work Zone Safety

SUMMARY

- **Planning Audits Provides Latitude for Positive Change**
- **Value Engineering and Design Build present specific safety issues that emphasize the need for Audits**
- **There is a range of issues related to Audits that warrant further discussion, and which provide alternatives and choices for application.**

SUMMARY

- **Clear Qualifications are Essential**
- **Size appropriate to the Project**
- **Relevant Experience Mix**
- **Broad Perspectives and Asset**
- **Broad Perspectives an Asset.**
- **Variety of Source Available**
- **Need for Certification**